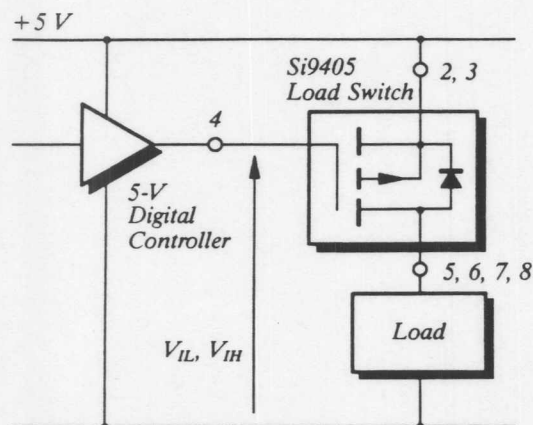


Power Management Using Siliconix Load Switches

Siliconix p-channel load switches (Figure 1) are designed to allow switching on the high side of a 5-V load—without the need for any extra components or a separate voltage rail.



Load Switch Truth Table $V_+ = 5.0\text{ V}, T_A = 25^\circ\text{C}$			
Input	Min V_{IH} (V)	Max V_{IL} (V)	Status of Load
0		0.5	On
1	4.5		Off

Figure 1

This simple drive configuration is possible because of the characteristics of the low threshold p-channel MOSFET. To turn on the MOSFET, a negative voltage must be applied to the gate, referenced to the source (see Figure 2). The source is connected to the +5-V rail, so a simple means of applying the negative voltage is to pull the input pin (the gate of the MOSFET) to ground. To turn the load switch off, the gate-source voltage must be well below the threshold voltage specification of the MOSFET. A minimum value of 0.5 V between the gate and source will ensure that the leakage current is below the maximum leakage current shown on the data sheet. Therefore to turn off the load, the input of the load switch must be within 0.5 V of the positive rail. Since the input is MOS, the load switch can be driven directly from logic controllers or gates. The load switches do not consume power themselves as there is no base current or supply current.

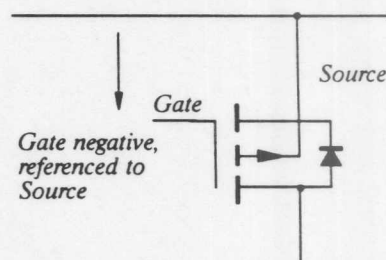


Figure 2

The configuration in Figure 1 is used to control parts of the circuit for a "power save" function. A load switch can also be used as a switch to isolate part of a circuit that has battery backup. However, since the load switch includes a diode from drain to source, the load switch must be connected in reverse in this application (see Figure 3). This circuit will allow battery backup to be applied only to the load shown. During normal operation the MOSFET is turned on by pulling the gate to ground. This enhances the MOSFET and causes the load current to flow through the MOSFET channel, which has a lower voltage drop than the diode.

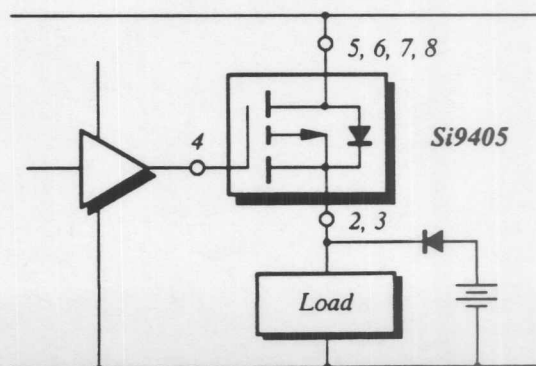


Figure 3

An n-channel MOSFET (Figure 4) can also be used as a high-side switch, but it requires a separate supply—at least 5 V higher than the rail being switched. To turn on the MOSFET, a positive voltage is required on the gate referenced to the source. When the MOSFET is on, the source is connected to the +5-V rail. Therefore the input must be positive referenced to the +5-V rail. Some computers have a 12-V rail that can be used for this purpose. Alternatively, this rail could be taken directly from the battery.

The cost of supplying the +12 V and the driver for the MOSFET needs to be weighed against the lower $r_{DS(on)}$ possible with n-channel load switches. The Si9405, with an $r_{DS(on)}$ of 200 m Ω driven from 5-V logic is the best choice for loads up to approximately 1 A. For higher currents, an n-channel may be more suitable.

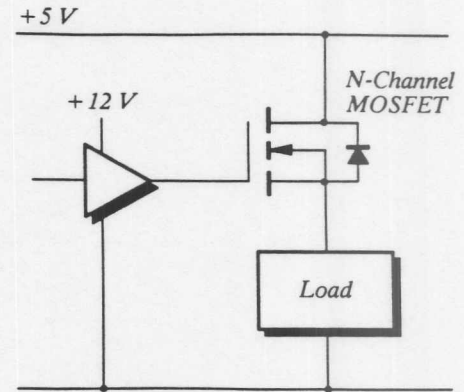


Figure 4

If a 12-V rail is not available, a simple logic-compatible means of driving the MOSFETs is possible (Figure 5).

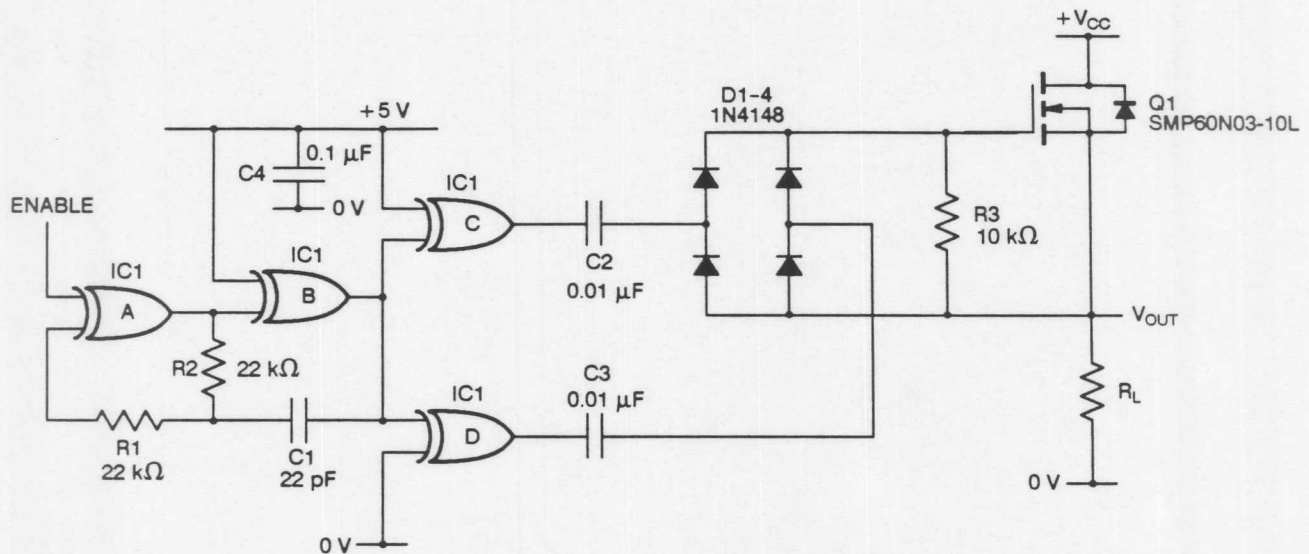


Figure 5

The complete family of 5-V logic compatible SO-8 load switches are shown in the table below.

Part Number	Description	$r_{DS(on)}$ @ $V_{GS} = -4.5 V$	$r_{DS(on)}$ @ $V_{GS} = -10 V$
Si9400DY	Single Load Switch	400 m Ω	250 m Ω
Si9405DY	Single Load Switch	200 m Ω	120 m Ω
Si9953DY	Dual Load Switch	400 m Ω each	250 m Ω each

SO-8 Package	Description	$r_{DS(on)}$ @ $V_{GS} = 4.5 V$	$r_{DS(on)}$ @ $V_{GS} = 10 V$
Si9956DY	Dual N-Ch Load Switching	200 m Ω each	100 m Ω each

TO-220 Package	Description	$r_{DS(on)}$ @ $V_{GS} = 5 V$ (m Ω)	$r_{DS(on)}$ @ $V_{GS} = 10 V$ (m Ω)
SMP60N03-10L	Low On-Resistance Switch	15 m Ω	10 m Ω

For more information on how to use Siliconix load switches to increase your battery life or for information on other products for battery operated equipment call our hotline at 800-554-5565.